CHAPTER 6
AIR POLLUTION CONTROL REQUIREMENTS

6-1. General. Off-gas from an air stripper may or may not need to be controlled, depending on the level of contaminants and on state and local regulations. If the loading of a contaminant or contaminants exceeds the amount allowed by regulation to be discharged to the air, treatment of the stripper off-gas will be required. This must be thoroughly evaluated, as air pollution controls will add major capital and O&M costs to the system. Packed columns use less air for a given loading of water and contaminant than do sieve tray air strippers. This is important when air pollution regulations require that the air leaving the unit be treated to remove the volatile organic chemicals before it is discharged to the atmosphere. In these cases, achieving the lowest airflow rate, and in turn the lowest air pollution control costs, may be the driving force in determining which type of air stripper to use.

$$x_{ai} L + y_{ai} G = x_{ae} L + y_{ae} G$$

which is the flow rate of contaminant *a*, where

L = molar flow of liquid (water)
G = molar flow of gas (air)
x_{ai} = mole fraction of contaminant *a* in influent liquid (water)
x_{ae} = mole fraction of contaminant *a* in effluent liquid (water)
y_{ai} = mole fraction of contaminant *a* in influent gas (air)
y_{ae} = mole fraction of contaminant *a* in effluent gas (air).

Assuming an uncontaminated air supply, we find:

$$y_{ai} = 0$$

$$x_{ai} L = x_{ae} L + y_{ae} G$$

Rearranging terms yields:

$$y_{ae} G = \left(x_{ai} - x_{ae}\right) L$$

$$\frac{G}{L} = \left(\frac{x_{ai} - x_{ae}}{y_{ae}}\right)$$

$$\text{\% Removal} = \left(\frac{x_{ai} - x_{ae}}{x_{ai}}\right) 100\%$$

where

p_{Te} = total pressure of gas(air) effluent

p_{ae} = partial pressure of contaminant in a gas (air) effluent

From Dalton's Law of partial pressures,

$$y_{ae} = \frac{p_{ae}}{p_{Te}} \frac{\text{mole}}{\text{mole}}$$

At equilibrium, from Henry's law:

$$p_{ae} = H_a \ x_{ai} \ \text{atm}$$

Substituting for p_{ae} yields:

$$y_{ae} \ p_{Te} = H_a \ x_{ai} \ \text{atm}$$

$$y_{ae} = \frac{H_a \ x_{ai}}{p_{Te}} \ \text{atm}$$

For the air polution worst case, it must be assumed that all volatile contaminants introduced to the stripper are transferred to the air. The only positive control of pollutant transfer to the air is the rate of contaminated water pumped to the stripper.

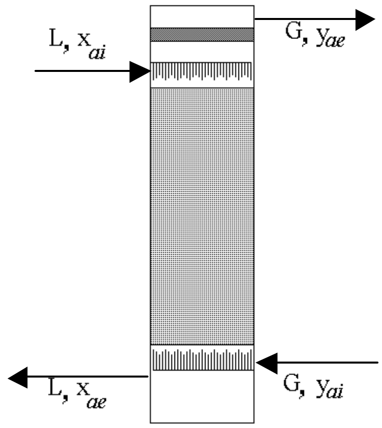

Figure 6-1. Material Balance.

6-2. Off-Gas Treatment. Activated carbon and thermal oxidation are commonly used to treat the off-gas. The unit efficiency of either method is directly proportional to the concentration of the contaminant in the off-gas. Activated carbon is simple but does not destroy the contaminant and may result in potential disposal costs. Thermal oxidation destroys the contaminant but is more complex. Air pollution control devices should be evaluated before determining which device to use. "As can be expected, the lower the concentration [of VOCs] in the gas stream the higher the control cost" (Blaszczak, 1995).

6-3. Innovative Air Pollution Control Devices. Information on innovative air pollution control devices can be found in the *Remediation Technologies Screening Matrix and Reference Guide*.